ANSI/EIA Standard

Configuration Management

ANSI/EIA 649

Revision A Version 9.2.1

December 3, 2001

This Revision is being Developed under ANSI Project PN-3721

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Foreword

Configuration management, a discipline popularized by its use in the acquisition of defense systems, is widely used for commercial products and services. When configuration management principles are applied using effective practices, return on investment is maximized and both product and service life cycle costs are reduced. This standard is intended to~~may~~ be used when establishing, performing, or evaluating configuration management processes in any industry, business enterprise or governmental organization.

~~This standard is intended to be used when establishing, performing, or evaluating configuration management processes in any industry, business or governmental enterprise.~~

In this standard, the Configuration Management ~~Process~~ is defined using functions and principles that are necessary to achieve configuration management. Sections 1 through 5 are normative. Annexes in this standard are informative.

This revision, supercedes all previous revisions of this standard in whole.

Development of this standard began in 1994, when the Electronic Industries Alliance's (EIA) G-33 Committee on Data and Configuration Management initiated a task to develop an industry configuration management standard. A core-working group was established under ANSI project PN-3414. An interim EIA standard (EIA/IS-649) was published in August 1995 after completion of the committee letter ballot process and approval by the EIA Engineering Department Executive Committee (EDEC).

ANSI project PN-3721 was initiated in March 1996, and a new core group was established to develop a revision of the interim standard to EIA/IS-649 in whole. The EIA letter-ballot process was completed in June 1997. An ANSI Ballot version was made available to interested parties for review in July 1997. The ANSI Ballot process was successfully completed in May 1998, and publication of EIA standard 649 was approved by EDEC.

ANSI project PN-4766 was initiated in March 2000, and another revision core group was established to develop a revision (Revision A) to the standard. This is the Revision A Draft which was prepared by the revision team.

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Introduction

Configuration Management (CM) applies the appropriate process and tools that are needed to establish and maintain consistency between a product requirements, product configuration information, and all relevant information about the a product. , as illustrated in Figure 1. The consistency established through the CM process ensures that products conform to their requirements and are identified and documented in sufficient detail to support the product life cycle. The consistency is also necessary to ensure product interchangeability, accurate product information, and safety of product operation and maintenance. As a result of this consistency, the small investment in resources necessary for effective configuration management is returned many fold in cost avoidance.

~~Configuration Management (CM) is the process and tools that are needed to establish and maintain consistency between product requirements, product configuration information, and a product.~~

See discussion papeer regarding figure

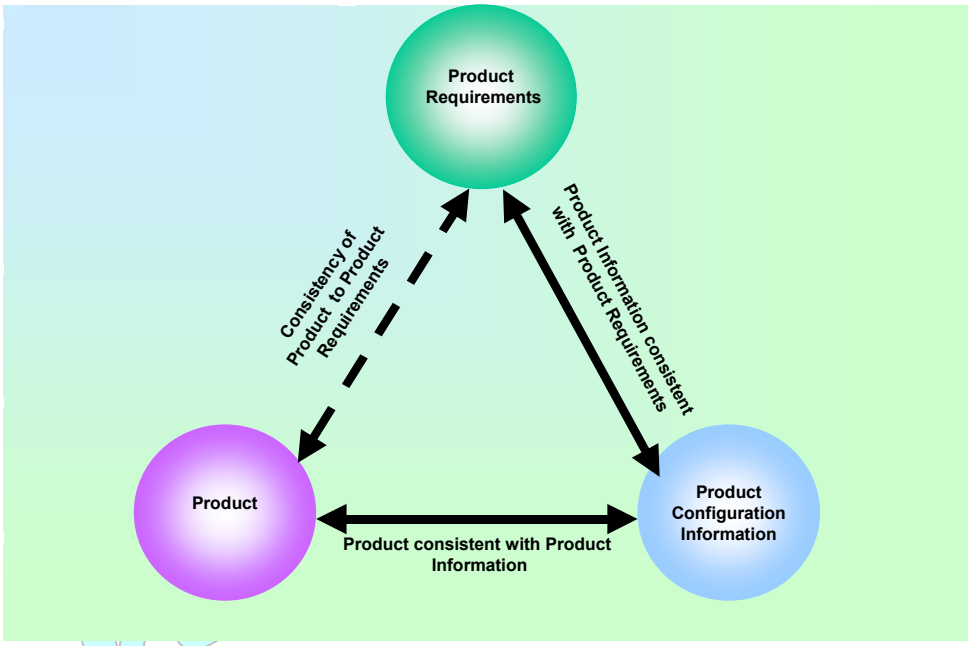

Figure 1 CM Consistency Triangle

The consistency established through the CM process ensures that products conform to their requirements and are identified and documented in sufficient detail to support the product life cycle The consistency is also necessary to ensure product interchangeability, accurate product information, and that product operation is performed within a safe configuration.

CM facilitates orderly identification of product attributes, CM ~~and~~ provides control of product information and product change~~s~~, which are necessary to: improve capabilities; correct deficiencies; improve performance, reliability, or maintainability; extend product life; or reduce cost, risk or liability.

CM implementation requires a balance and consistent implementation of CM functions, principles, and practices throughout the product life cycle. Benefits from the CM process can only be ensured when all five of the functions work together throughout the entire product life cycle

The term ~~A~~ product in this standard should be interpreted as applicable to the generic product categories of hardware, software, processes, tools, data, materials, or services. Software Configuration Management (SCM) is integral to CM, and the same objectives, purpose and benefits of CM apply to software as to any other product.

The small investment in resources necessary for effective configuration management is returned many fold in cost avoidance.

1 Scope

This standard defines configuration management (CM) terminology, establishes a CM process and provides the underlying fundamental principles for each of the CM functions. ~~provides CM implementation guidance.~~ Aliases for CM terms are provided as entries in CM and Product Life-cycle Aliases Tables. The CM process is comprised of five interrelated CM functions supported by 43 principles and implementation guidance.

The formality of the CM controls is commensurate with the type of product or application environment. The highest formality will exist in a complex product environment that requires a robust CM approach, such as an electronic system, a military weapon, or other complex products that must be supported over a complex product life cycle. The degree to which the CM principles in this standard apply to the product will vary over the life cycle of the product. Many of the CM principles will not apply to a product during every phase of the product's life cycle.

When CM is applied to less complex products, less CM process formality may be required to provide needed consistency between the essential requirements, product information and product attributes. . The information in Annex [B] is provided to assist in planning and implementing CM practices that provide the needed controls which are appropriate for the product environment.

This standard is not intended for use as a compliance document, or an evaluation mechanism for CM programs. However, it is intended for use as a source and reference document for either purpose. The application of the functions and principles in this standard to a product, or for a project or enterprise, will enable the user to plan and document an appropriate CM program.

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2 Terms

Neutral terms are used in this standard and are provided in Table 1 and 2. There is no intent to express preference for any particular terminology set. When planning and documenting a CM program, these terms and other aliases may be substituted for the neutral terminology.

References to a product in this standard should be interpreted as applicable to the generic product categories of hardware, software, processes, tools, data, materials, or services.

References to terms such as the enterprise, performing activity, developing activity, or producing activity refer to that organization or agency that has the responsibility for performing configuration management for a given product during some period of its life cycle. This organization could be a commercial enterprise, a contractor, a subcontractor, or a government agency.

Configuration management functions related to a given product may be the responsibility of several organizations during its life cycle (e.g., one organization that designs and builds a product performs configuration management during the definition and build phases; a second organization, that is responsible for upgrading the product and servicing malfunctioning units, performs configuration management during the operation phase).

References to the customer should be interpreted as the organization(s) that specify requirements (performance attributes) for the product or those that acquire and use the product. A customer may be external to the developing and producing organization, or may be an internal customer such as marketing, management, or the using department. When the term "customer" is used alone, either condition applies. When one condition applies, but the other does not, customer is modified by either "external" or "internal," as applicable.

In Table 1, the life cycle of a product has been broken into different phases with a generic title and characteristic for each phase. These phase names are intended to be as generic as possible so that they can be easily mapped to the myriad of different life-cycle models in use.

To encompass a broad range of environments, Table 1 illustrates some of the aliases for each phase.

Note: 1. Alias or characteristic may apply in more than one product phase

Table 1 — Phases of a Product's Life Cycle

Terms Used	Conception	Definition	Build	Distribution	Operation	Disposal
Aliases	Marketing Concept Exploration Study Research Exploration Predevelopment	Development Design Engineering Program Definition & Risk Reduction Engineering & Manufacturing Development Source Coding Software Build [1]	Fabrication Production Construction Manufacturing Software Build[1]	Sales Delivery Installation Fielding Deployment	Operational Maintenance Warranties Service Life Performance Operation & Support Repair On orbit	Removal- From- Service Disposition Decommissioning
Characteristics	Need Opportunity Mission Analysis Trade-Offs Investigation Survey Functions Pre-Concept & Concept Definitions	System Definition Specification Architecture Preliminary Design Detailed Design Software Code & Test Manufacturing Planning Prototyping Testing Evaluation	Facility Construction Production Assembly Installation[1] Inspection	Order Supply Stock Transport Acceptance Deployment Installation Setup	Use Utilization Operate Maintain Service Depreciate Sustain Recover Modify Upgrade Modernize	Mothball Discard Deactivate Destroy Disassemble Scrap Recycle Disposition Archive Legacy Retrieval Environmental- Impact Historical Significance

Regardless of the titles chosen for these phases, or whether the product is a facility, computer software, an airplane or a machine screw, at some time in its history a product will go through all or most of these phases. The phases can have considerable overlap, or the sequence of the phases might change or be repeated (e.g. recommissioning). ~~A~~ Approved configurations of a product can be in build, distribution, operation, and disposal phases simultaneously. Changes to approved configurations can be occurring simtaneously during any lifecycle phase. ~~, while changes to its current design are in the definition phase~~

[1]

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Table 2 — Table of Common Aliases

Terms Used	Alias *(Synonymous)* or Equivalent *(Conceptually Similar)* Terms
Attributes (Product Attributes ???)	Characteristics, Requirements
Change Board	Configuration Control Board; Change Control Board; Change Review Board; Program Review Board; Integrated Product Team
Change Notice, Document Change Notice	Engineering Order, Engineering Change Order, Engineering Change Notice, Specification Change Notice, Amendment
Change Proposal	Engineering Change Proposal, Engineering Change Package
Change Request	Engineering Change Package, Change Request/Directive
Change Requester	Originator, Preparer of request
Change Sponsor	Cognizant Engineer or Manager
Configuration Change Management	Configuration Control, Change Control
Configuration Identification	Product Definition
Configuration Information	Specification, Requirements Document, Design Basis, Attributes, Interface Document, Interface Control Document, Engineering Drawing, Design Information, Design Output, Software Requirements Specification, Software Design Document, Software Product Specification
Configuration Status Accounting	Product Configuration Information
Configuration Verification and Audit	Product Configuration Verification, Functional and Physical Configuration Audit, Product Consistency Verification
Customer – External	Buyer, Eng User, External End User, Procuring Activity, Acquirer, Authority
Customer – Internal	Management, Marketing Department, Specification Activity, Internal user, etc.
Design Information/Documentation	Engineering Drawings and associated lists ; product defination information
Design Release Baseline	Developmental Configuration, Release Baseline
Effectivity	Affected Serial Number(s), Change Applicability, Series, Incorporation Date(s), Block, Lot, Point of embodiment
Enterprise	Organization, Contractor
Fixed (as baseline)	Established
Group Identifier	Lot Number, Batch Number, Block Number
Interface Document	Interface Control Document, Interface Control Drawing, Interface Specification
Life Cycle Phases	(See Table 1)
Process	Methodology
Product	Hardware, Software, Process, Data, Material or Service, Configuration Item, End Item, Item, System, Set, Group, Component, Part, Assembly, Unit, Entity
Product Configuration Baseline	Product Baseline
Product Information [configuration/definition]	Configuration Documentation, Product Use Documentation, Test Document other derived information
Product Servicing, Support	Integrated Logistic Support, Logistic Support, Acquisition Logistics
Product Structure	Hierarchy, Product Tree, Pyramid, Top-down breakdown, Indentured listing, Bill of Material (BOM)
Product Use Information/Documentation	Operation and Maintenance Instructions and other derived information, Operational Information, Technical Manual, Technical Order
Requirements Baseline	Functional Baseline, Performance Requirements, Promise to Customer, Allocated Baseline, Contractual Baseline,
Specification	Requirements Document, Catalogue Sheet
Supplier	Performer, Developer, Designer, Subcontractor, Vendor, Seller, Provider
Unit Identifier	Serial Number
Unique Identifier	Part Number, Nomenclature, Item Name, Title, Name, Dash Number, Product Identifier, Model, Version, Document Identifier
Variance	Deviation, Waiver, Engineering or Production Departure, Alteration, Nonconformance

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3 Definitions

For purposes of this standard, the following definitions apply:

Where more than one meaning is commonly attributed to a term, alternate numbered definitions are provided . Words included in the definitions in **bold-face** type are included in this list of definitions See Subject/Key Word Index for more information.

application environment: 1) Where a **product** is used (e.g., commercial systems, defense systems, and facilities); 2) Where a system or process is executed within an enterprise (i.e. Material Handling, Design Development process, etc…)

approval: Authorization from a designated authority or body that a **product**, **process, or information** is complete and suitable for its use.

approved: A state signifying **approval**.

archived information: Information that has been retained for historical purposes that can be retrieved and is usable over the time designated for retention.

attributes: see **product attribute**(s)

change: See configuration change.

configuration: (1) The **product attributes** of an existing or planned **product**, or a combination of **products**; (2) one of a series of sequentially created variations of a **product**.

configuration audit: The CM Function that reviews processes and **product**s to validate compliance with **requirement**s, and ~~to~~ verifies ~~verify~~ that **product**s have achieved their required **attributes** and conform to released **product definition information**.

i.e., (1) The review of procedures, processes, and systems for compliance and consistency. (2) Examination to determine if a product conforms to its product definition information. (3) Assessment of performance requirements to observed and measured information.

Note: These audits are sometimes divided into separate functional and physical configuration audits.

configuration baseline identifies and declares the **attributes** of a **product** at a point in time, which serves as reference for activities throughout its **life cycle**.

configuration change: An alteration to a **product** and its **product configuration information**

configuration change management: The CM function that ensures changes to a **configuration baseline** are properly identified, recorded, evaluated, **approved**, incorporated, and verified.

Move below to Annex C

(2) The CM process concerning the systematic proposal, justification, evaluation, coordination, and disposition of proposed configuration changes; and the implementation of all approved and released configuration changes into (a) the applicable configurations of a product, (b) associated product configuration information, and (c) supporting and interfacing products and their associated product information.

configuration identification: The CM function of (1) selecting, describing, and organizing **product attributes**; (2) assigning and applying unique identifiers to a **product**, its components, and associated **product configuration information.**

configuration management (CM): A process that establishes and maintains consistency of a **product** with its **requirements** and configuration information throughout its **life cycle**.

configuration status accounting (CSA): The CM function managing the capture, storage, retrieval, and access of **product configuration information** necessary to account for the configuration of a **product**.

configuration verification: The CM function verifying that a **product** has achieved consistency and accuracy of its product **requirement**s, and **product configuration information.**

data: The representation of facts, numbers, or datum of any nature that can be communicated, stored, and processed to form information. See **Information.**

design information: Technical information resulting from translating **requirement**s for a **product** into a complete description of the **product.** (see **product definition information**)

disapproval Conclusion by the appropriate authority or body that a **product**, **process, or information** is either incomplete or not suitable for its use.

document: Information and its support medium. (e.g. Record, specification, drawing, report, standard) Note: The medium may be paper, photograph, digital files, optical computer disc, magnetic, electronic storage (e.g. Digital documents), or a combination thereof.

effectivity: A designation defining the product range (e.g., serial, lot numbers, model, dates) or event at which a change to a specific **product** is to be (or has been) effected, or to which a variance applies.

firmware: The combination of a hardware device and computer instructions, or computer data that reside as read-only software on the hardware device.

fit: The ability of a product to interface or interconnect with, or become an integral part of, another product.

form: The shape, size, dimensions, and other physically measurable parameters that uniquely characterize a **product.**

function: The action or actions that a product is designed to perform

functional attributes: Measurable performance parameters.

Note: These are expressed in terms of quantitative parameters, (e.g. range, speed, lethality, reliability, maintainability, safety, MIPS~~,~~ and ~~-~~operating and logistical parameters with their respective tolerances when applicable .)

group identifier: An alphanumeric identifier that (1) uniquely identifies a group of like units of the same **product** which are manufactured or assembled under uniform conditions ,and are expected to function in a consistent manner (e.g. lot). (2) ~~is used to~~ uniquely designates ~~designate~~ a specific volumetric quantity (batch) of a material (usually a chemical mixture) created at the same time and expected to have properties similar to, but not necessarily the same as, other batches created at other times.

hardware: Products and their components (e.g., mechanical, electrical, electronic, hydraulic, pneumatic) made of material.

information: A combination of data and rules, recorded, classified, organized, related, or interpreted within a certain context.

interchangeable: A **product** which is capable of being exchanged with another **product** which has equivalent or similar **product attributes** without alteration of the **product**s themselves, or of adjoining **products**, except for adjustment.

Interface : The **product attributes** that exist at a common boundary of two or more **products**.

interface control: The process of identifying, recording, and managing **product attributes** to the common boundary ~~interfacing~~ of two or more **product**s provided by one or more organizations.

Interface information is recorded information (e.g. interface control drawing) that depicts **product attributes** of an interface between related or co-functioning **product**s.

Move to annex C or near principal

life cycle: A generic term for the entire life of a **product** from concept to disposal.

lot identifier : See Group identifier

model identifier: An alphanumeric identifier, unique to the issuing organization that is used with **product**s as a relatively unchanging base identifier for the serialization of the **product**.

Move to Annex c: The identifier remains unchanged when the product identifier for the assembly/product is changed unless the performance/interoperability of the assembly/product is significantly changed. Synonyms include model number, and nomenclature.

nomenclature: (1) Names assigned to kinds and groups of **product**s, (2) formal designations assigned to products by customer or supplier (e.g., model number or model type, design differentiation, specific design series or configuration).

nonconformance: Non-fulfillment of a specified requirement for a **product**

operational configuration: The 'state' (i.e., on/off, open/closed, operating / not operating) of **product**s, systems, or components at a particular point in time. The actual operational configuration will vary depending on overall product status and condition.

operational information: Information that supports the use of a **product** (e.g., operation, maintenance, and user's manuals/instructions, procedures, and diagrams).

organization identifier: An alphanumeric identifier, unique to a specific organizational entity (e.g., Commercial and Government Entity (CAGE) code, Data Universal Numbering System(DUNS), or Design Activity Identifier(DAI), Name, Acronym, Address, Logo).

- Add enterprise identifier, organization code to alias
- Change all associated text
- Move to annex: NOTE — As used in practice, the code denotes the organization responsible for design and/or manufacture of a product. A product may be designed by one organizational entity and manufactured by a different organizational entity with a different organization code.

Move to annex : NOTE — As used in practice, the code denotes the organization responsible for design and/or manufacture of a product. A product may be designed by one

performance: A quantitative measure characterizing a physical or functional **attribute** relating to the execution of an operation or function.

e.g., quantity (how many or how much), quality (how well), coverage (how much area, how far), timeliness (how responsive, how frequent), and readiness (availability, mission/operational readiness).

physical attributes: Quantitative and qualitative expressions of material features.

e.g., composition, dimensions, finishes, form, fit, and their respective tolerances.

product : Something that is used or produced to satisfy a need or is the result of a process.

e.g., facilities, systems, hardware, software, firmware, documents, processes, materials, services.

Product attribute(s): Performance, **functional**, and physical characteristic(s) of a **product**.

product configuration information: Information about a **product** in support of its **life cycle** phases. This includes **product definition** and supplementary types of information e.g., operating procedures, maintenance procedures, disposal methods) necessary to support all phases of the **product**'s **life cycle**. However, it does not consist of project or administrative types of information (e.g. cost, schedule, and planning etc.***Update alias table***

product definition information: Technical design definition information that defines **product attributes** and is the authoritative source for configuration definition. (e.g., specifications, drawings, source code) Other types of information are derived from the **product definition information** to develop the **product configuration information** (e.g., operating procedures, maintenance procedures, disposal methods) necessary to support the **product**. ***Update alias table***

product identifier: A name or alphanumeric identifier, unique to the issuing organization, used to designate parts, assemblies, or **product**s of the same configuration, and to differentiate them from other **product**s.

Note: These identifiers may include a supplementary identifier used to distinguish one of several sequentially created configurations of a product from the previous configuration of the same product (i.e. revision or version).

Add - **part number or name**: see part identifier.

release: Dissemination or distribution of information and/or products after **approval** and is subject to configuration change management.

requirement : (1) Specified essential **product attribute**. (2) Need or expectation that is stated, generally implied, or obligatory

retrofit: The incorporation of new design parts, or software code, resulting from an approved **configuration change,** into **product**s already delivered.

rework: An action applied to a **product** to resolve **nonconformance**.

specification: **Information** that explicitly states the essential technical **attributes** for a **product**.

unit: 1)One of a quantity of items (e.g., **product**s, parts); 2 identifier of measure

unit identifier: A sequentially issued alphanumeric identifier unique to the part or assembly on which it is placed. It is used to designate the specific unit of the **part**, or assembly, and to differentiate it from all other units of that **part**, or assembly, with the same design.

validation: confirmation that the **requirement**s for a specific intended use or application have been fulfilled

variance: An approved departure from a specified **requirement**(s).

Note: A variance does not require a corresponding revision to current approved product definition information. It may be temporary, permanent, or for a specific use.

verification: Confirmation that specified requirements have been fulfilled by the product.

version identifier: See Product Identifier.

version: A particular form of **product** which varies from other forms of the **product.**

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4 Symbols and Abbreviations

The following symbols and abbreviations are used in this standard:

ACDM— Association of Configuration and Data Management
ANSI — American National Standards Institute
ASCII — American Standard Code for Information Interchange
ASME — American Society of Mechanical Engineers
ASQ —American Society for Quality
CM — Configuration Management
CMM — Capability Maturity Model
CPIN — Computer Program Identification Number
CSA — Configuration Status Accounting
DoD — Department of Defense
EDI — Electronic Data Interchange
EIA — Electronic Industries Alliance
ICD — Interface Control Document
IEC — International Electrotechnical Commission
IEEE — Institute of Electrical and Electronics Engineers
IGES — International Graphics Exchange Standard
ISO — International Organization for Standardization
NDIA — National Defense Industry Association
NIRMA -- Nuclear Information and Records Management Association
OTS — Off-the-Shelf
PDM — Product Data Management
SCM — Software Configuration Management
SEI — Software Engineering Institute
SGML — Standard Graphic Markup Language
SOLE — International Society of Logistics Engineers

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5 CM functions and principles

The CM process described in this standard is comprised of five CM functions supported by 43 CM principles that together provide a flexible implementation structure. ~~The CM process is used to provide consistency between product requirements, product configuration information and product attributes.~~

The five CM functions are 1) Configuration Management Planning and Management, 2) Configuration Identification, 3) Configuration Change Management, 4) Configuration Status Accounting and 5) Configuration Verification & Audit.

Planning and Management provides the foundation of the process, Identification, Change Management and Status Accounting are the weight bearers of the process, while Verification and Audit provides oversight of the process, as illustrated in figure 2.

These functions are described in Sections 5.1 through 5.5:

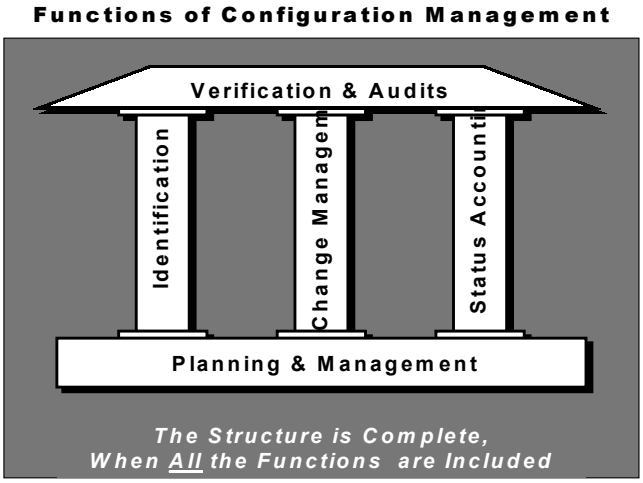

Figure 2 CM Functions

Configuration Management implementation requires a balance and consistent implementation of these CM functions throughout the product life cycle. Benefits from the CM process can only be assured when all five of the functions work together throughout the entire product life cycle. Considerable costs may be incurred to reestablish the accuracy of product information or relationships if the configuration is not carefully maintained throughout the life cycle.

These benefits are realized only if there is consistency between a product, its attributes, and the product information. To achieve consistency of the product attributes and the information about them, the performance, functional, and physical attributes are first defined in configuration documentation. The configuration information becomes more detailed and definitive as the life cycle progresses, and is used throughout the life cycle to define configuration baselines (technical contracts). The defined attributes in the baseline must then be achieved in a product. Both the product and its information must also be verified for consistency. Consistency is maintained throughout the product life cycle by identifying and evaluating the impact of all proposed changes through the configuration change management process (see 5.3), including the verification that the product and all associated product information have been updated and continue to be consistent.

In order to apply the functions and principles of this standard, it is necessary to perform and implement CM planning which considers all of the CM functions and underlying principles. Guidance is provided in Annex B to assist the application process, while Annex C provides informative implementation guidance.

Informative Annex information is provided to assist in CM implementation planning:

Annex A provides a tabulated summary of the CM functions and principles.

Annex B provides guidance for application of this Configuration Management Standard

Annex C provides clarifying text (examples and illustrations) for the CM functions

Annex D provides a list of other associated consensus standards

The Principles for each of the CM functions are illustrated in Figure 3 and are contained in sections 5.1 through 5.5.

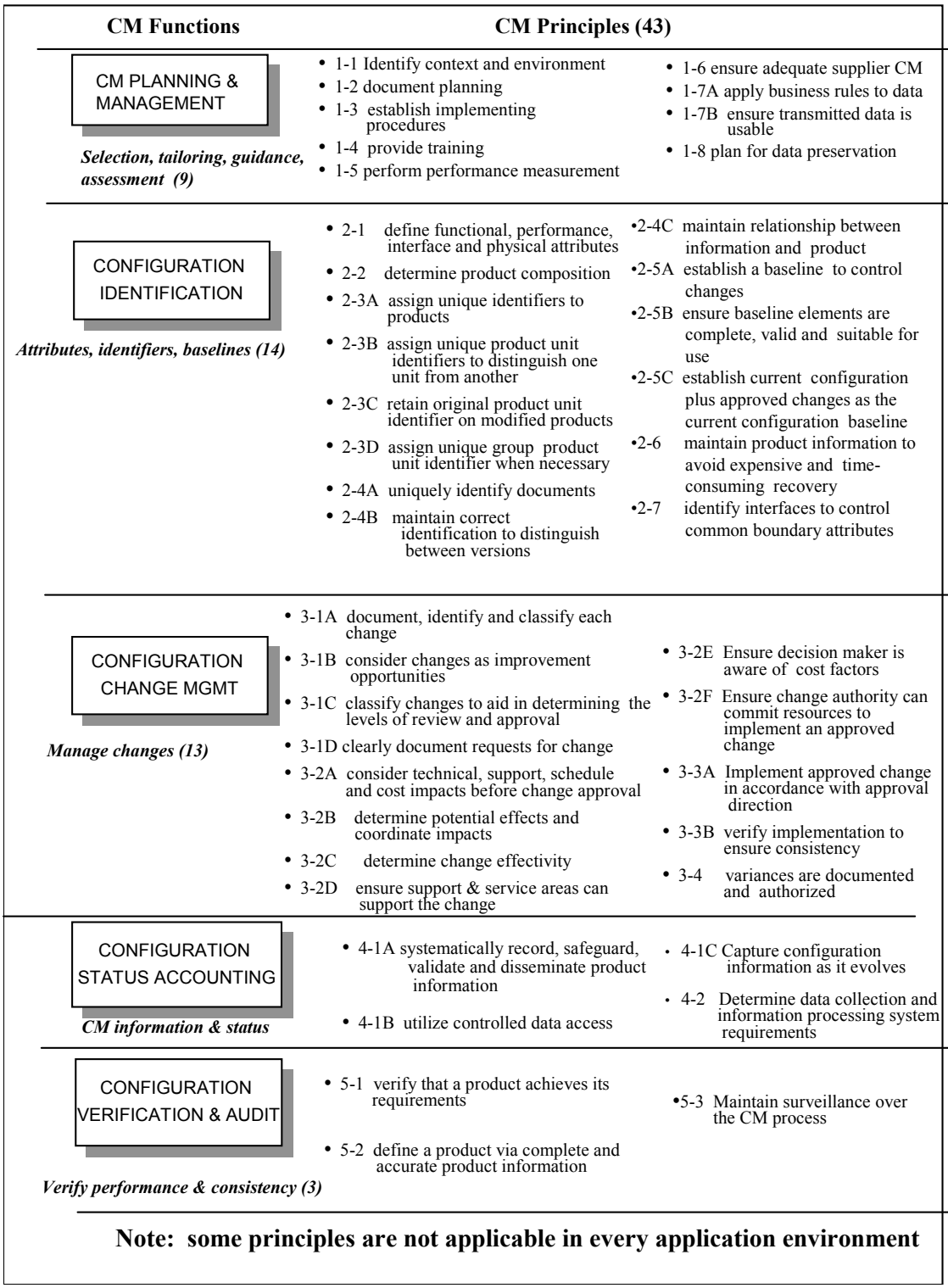

Figure 3 — Configuration Management Functions and Principles

5.1 Configuration Management Planning and Management

FUNCTION 1: Plan implementation of the CM functions for the context and environment in which they are to be performed; manage in accordance with the planning.

The purpose of CM planning and management is to ensure:

- Appropriate level of CM functions are selected and applied throughout the product life cycle
- Organizational responsibilities for CM functions are assigned and procedures are in place.
- Adequate resources and facilities for product implementation are applied
- Measurements are considered as a basis for continuous improvement
- Suppliers and subcontractors perform adequate configuration management
- The organization's product configuration information processes are integrated
- The intellectual capital of the organization is protected.

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Comprehensive CM planning and management over the product life cycle results in defined and effective CM functions that work within the environment in which they are being implemented. CM functions focus on the product and the customer, and shape the implementation of procedures resulting in effective product configuration information management, cost avoidance, and product stability.

5.1.1 Identify Context and Environment

PRINCIPLE 1-1: Identify the context and environment for a particular product in which CM is to be implemented to determine the specific CM value-adding functions and levels of emphasis.

When accomplishing CM planning, it is necessary to tailor the CM functions to be utilized by the organization to be appropriate for the products being provided by that organization. Many different factors will influence the degree of rigor to be incorporated into the CM functions, including:

——product application environment,
—type of support to be provided (i.e., factory support, dealership support, independent service center support, customer support, or no support required),—life cycle phases and the degree to which the product will go through them (e.g., definition, build, distribution, operations, and disposal phases).
—product and organizational constraints (i.e., product scope, product importance, product complexity, production quantity, quality needs, number and size of organizations involved, CM process maturity, budgets, and schedules),

CM planning should be re-evaluatedfollowing significant change affecting the context and environment (such as changes in contractors, or contractor responsibilities, changes in resource availabiliites or changes in the product).

5.1.2 Document CM Planning

Principle 1-2: Document how the Organization will implement of CM functions to provide consistency between the product attributes, product definition information and the product's configuration information, throughout the applicable phases of the product's life cycle.

Perform CM planning, and document it.. The form and format of the planning documentation, whether it is included with other project planning or is a standalone plan, is not critical. Execution of the CM planning is critical for successful CM process implementation.

5.1.3 Assign Responsibility and Apply adequate CM Resources

Principle 1-3: Identify resources required to implement the CM functions and ensure they are applied throughout the product's life cycle.

The resources applied to essential to perform the activities required to ~~implment~~implement the CM planning. The required resources may include personnel, information systems, office equipment or tools and may be distributed throughout an organization, subcontractor or supplier.

5.1.4 Implementation Procedures

PRINCIPLE 1-4: Establish procedures to define how each CM function will be accomplished.

CM procedures provide the detailed how-to steps to implement the CM functions. Procedures should be unambiguous, succinct, and written at a level of detail that is commensurate with the intended user skill level. As with planning, procedures may be applied to a range of products, or tailored for individual products. Procedures define implementation of CM functions and must be carefully evaluated to ensure that they are consistent with CM planning.

5.1.5 CM Training

PRINCIPLE 1-5: Conduct training so that individuals understand their roles, responsibilities, accountabilities, authorities and the procedures for performing the specified CM tasks.

Training provides the workforce with a consistent basis for understanding the CM functions and procedures, and their application to the product. CM Training addresses both performance of assigned CM tasks and cross-training to provide awareness of relationships and interactions with others having CM-related responsibilities.

5.1.6 Performance Measurement

PRINCIPLE 1-6: Assess the effectiveness of CM plan implementation and performance of the configuration management functions with performance measurements.

The information derived from measurements is used to understand problems and inefficiencies in products and processes, to assess the extent of those problems and inefficiencies, and to provide insight in making necessary corrections and improvements. CM functions and procedures are reviewed and revised periodically, using performance measurements data. Metrics are selected and adjusted as appropriate for the program environment and product life cycle phase.

5.1.7 Supplier Configuration Management

PRINCIPLE 1-7: Configuration management includes the responsibility to flow down responsibility for CM performance of subcontractor(s). ~~CM requirements to suppliers~~.

Flow down of CM requirements to suppliers is an important CM planning activity. These requirements may require tailoring. Once established and qualified, supplier performance to CM requirements should be monitored (e.g., via data reviews, configuration change management, design reviews, product test results, configuration audits, and CM surveillance reviews). ~~In cases of Commercial Off The Shelf (COTS) supplied items, supplier CM flow down may not be appropriate yet contingencies should be planned.~~

5.1.8 Planning for Data Management, Data Interoperability and Exchange

Effective access, sharing, and exchange of CM data, including common configuration management business objects and ad-hoc queries to CM information in databases, depends upon proper CM data definition and relationships that are consistent with the CM principles in this standard. The process employed to provide access, sharing, or exchange is typically accomplished using one of many available product data management (pdm) tools or systems, often customized to a specific organizational environment. ~~The capabilities of the process, tools or systems should embody the CM principles in ANSI/EIA-649 and the business rules and definitions in EIA-836.~~

PRINCIPLE 1-8A: Plan and identify information status levels for managing product configuration information.

~~Information status levels helps~~Information status levels help define the ~~the levels of~~ Configuration Management being applied to information as it proceeds throughout its life cycle.

— **Work-In-Process products** are controlled by the developer or development team. ~~with limited access and little expectation of change notification beyond the developer/development team.~~

— **Released products** ~~are have~~ are under ~~high expectation that~~ access control and ~~involvement in~~ change management ~~will be profided to~~for authorized users.

— ~~**Archieved**~~**Archived products** are not expected to ~~require~~ change ~~management~~.

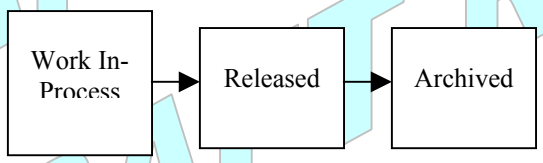


Figure 5 Information Status Levels

PRINCIPLE 1-8B: Ensure that a transmitted data product is usable.

Ensure delive~~r~~red data products are complete and appropriate for the users computing environment and acceptable to the user whether r exchange is by physical media, electronic data interchange (EDI) or other means.

When data are provided in floppy disks, tapes, CD-ROM, or other physical media, appropriate identification is affixed to the media to clearly identify the configuration of its contents. When it is impracticable to include all of the file identifications, a reference to an accompanying list, or to a "Read Me" file should be created and tendered as part of the media.

5.1.9 Planning for Data Preservation

PRINCIPLE 1-9: Plan for long-term data preservation by addressing the information technologies used to store, retrieve, and interpret data.

The lifecycles of the product, the information technology used to interpret the data, and the storage media are considered when addressing the preservation of data.

— Product: The life cycle of the product associated with the data and the applicable legal requirements are considered to determine what data must be retained and for how long.
— Application: The life cycles of the technologies required to interpret the data and accurately present it in human readable form are considered to determine when the technologies (and, often the data) should be updated to avoid technology obsolescence.

— Storage: The life cycles of the technologies used to store the data, i.e. the physical media, on which data is stored, and the technologies required to retrieve data from the physical media are considered to determine when the physical media and/or the technologies (and, often, the data) should be updated to avoid technology obsolescence.

~~organization identifier~~: ~~An alphanumeric identifier, unique to a specific organizational entity (e.g., Commercial and Government Entity (CAGE) code, Data Universal Numbering System(DUNS), or Design Activity Identifier(DAI), Name, Acronym, Address, Logo).~~

5.2 Configuration Identification

FUNCTION 2 : Unique ~~I~~identifiers are established for selected product attributes, product information and products. These identifiers are then used as the basis for ~~control~~ configuration management. ~~(e.g., unique product identification, change status, etc.) and verification of configuration consistency.~~

The purpose~~s~~ of configuration identification ~~are~~ is to ensure~~sure~~:

- Product attributes that are used to define agreed-to requirements;
- A product structure for organizing the composition of the product.
- Selection of products and product information to be "Ernie has the text for this" ~~included in the CM system is based on importance, functionality, complexity, risk, and/or cost~~
- ~~That a product structure (see 5.2.2) is used to correlate the product requirements, information, changes and assessment results.~~
- ~~Product attributes are used to define agreed-to requirements, which are used to develop and/or produce the product;~~
- Products, baselines, interfaces and ~~and~~ information ~~are~~ to be identified and marked.

~~Configuration identification enables the establishment and maintenance of consistency between product attributes, product information and products. This consistency is maintained as the product proceeds through its lifecycle and the configuration information becomes more detailed and definitive. The defined attributes are then achieved in a product.~~

The configuration identification function interfaces with the ~~functions of~~ change management, ~~and~~ verification, and audit functions. ~~Changes to the baseline defined by the configuration identification function are identified and evaluated using a change management process, which includes verification that the product and associated product information have been updated and continue to be consistent.~~

5.2.1 Product Configuration Information

PRINCIPLE 2-1: Define the functional, performance, interface and physical attributes of a product. ~~in configuration information.~~

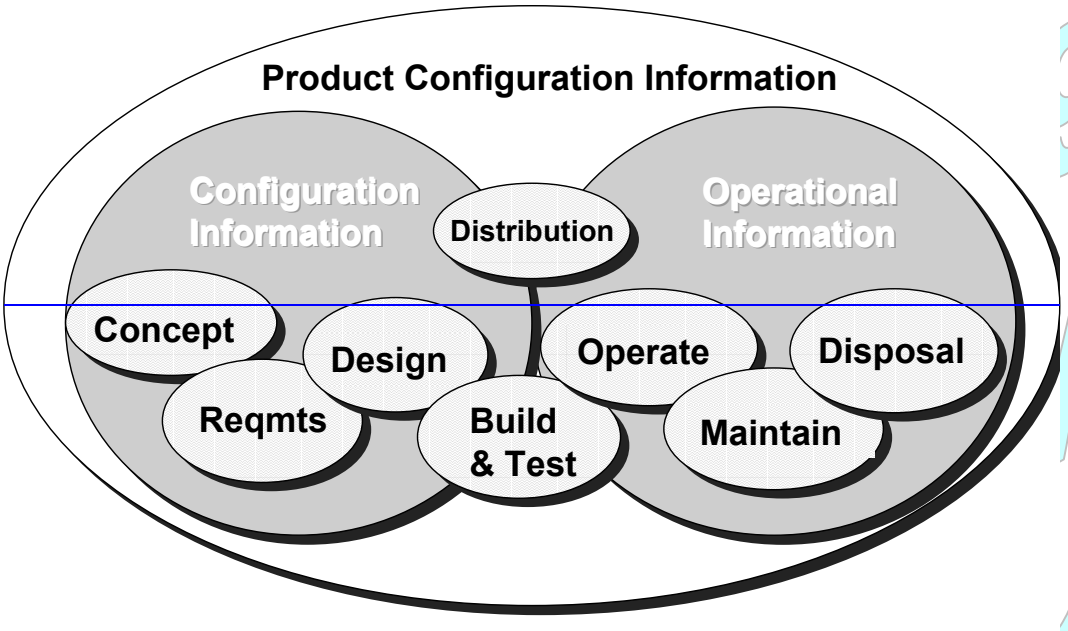
~~Each organization's internal management standards should be:~~

- ~~based upon the intended end use(s) for their products throughout the product life cycle;~~
- ~~delineate the appropriate configuration and other product information to be provided.~~

~~The entire set of selected product information is organized (i.e; grouped, categorized) to facilitate effective and efficient retrieval and maintenance. The product information should be stated in such a manner that it is complete and usable whenever and wherever it is needed throughout the product's life.~~

The product definition information, is used to describe the product's performance, functional, and physical attributes, and consists of requirements and design information. Statements that describe a product's use are supported by, and consistent with, the statements in the configuration information, defining the product's attributes.

~~Figure 6 illustrates generic categories of product configuration information and how they relate. The two major sets of information are configuration information and operational information. Only product configuration information necessary for control of product attributes is included in the product's defintion information and subjected to formal configuration control.~~



(Need to change Configuration Information Circle to ~~Configuration~~ Product Definition Information)

Figure 6 — ~~Composition of~~ Product Configuration Information Life Cycle

Figure 6 illustrates generic categories of product configuration information and how they relate throughout the products life cycle. The two major sets of information are configuration information and operational information. Only product configuration information necessary for control of product attributes is included in the product's definition information and subjected to formal configuration control.

~~The product definition information, is used to describe the product's performance, functional, and physical attributes, and consists of requirements and design information. Statements that describe a product's use are supported by, and consistent with, the statements in the configuration information, defining the product's attributes.~~

Operational information is used to provide needed procedures and technical information needed by users and support personnel to operate, service, maintain and dispose of,~~-~~ the product. The operational information is extracted or derived from the product configuration information. Operational information includes operating procedures, maintenance procedures, spare parts lists, and disposal methods.

5.2.2 Product Structure

PRINCIPLE 2-2 : Determine a product's composition ~~(i.e., the relationship and quantity of parts that make up the product)~~ using its product definition information.

A product structure is a common technique for organizing the composition of a product. It is a representation of the breakdown hierarchy (i.e., product tree, pyramid, indentured listing, the relationship and quantity of parts that make up the product, etc.) of a complex product, from the top down to the lowest level. Each level references associated product definition information(e.g., engineering drawings, parts lists, specifications, software requirements and design documents, and processes and procedures). The product structure shows the top-down relationships among the various parts that make up the product.

5.2.3 Identifiers for Products

Principle 2-3a : Assign unique identifiers to products so that they can be distinguished from other products; one configuration of a product can be distinguished from another; the source of a product can be determined; and the correct product definition information can be retrieved.

~~Comment --Include Definitions for Enterprise and Supplier Identifiers in section 3 and apply consistently in section 5.~~

There is a variety of identifier types that should be selectively used to identify, segregate, and control products and individual units of a product. They are:

1. The model identifier. The model identifier should be used to distinguish major products (configuration items) Core Group to deal with this item within a system or system component. Related to model identifier is the model nomenclature name. The model nomenclature name should provide a specific unique naming convention that is directly related to the model identifier part name.

2. The product part identifier (i.e., item identifier per ASME Y14.100M).

3. The unit or group identifier. This type of product identification is used to support traceability at of a built item any level within the product structure. This type of identifier covers both, the identification of individual units within a product (e.g., serial number) and the identification of groups of units within a product (e.g., lot number).

4. The bulk material identifier. This identifier is used to distinguish one batch of bulk material from another.

5. The organization identifier. This identifier is used to distinguish:

- Different products partor items with the same product part identifier developed by different sources of design (i.e: design activity per ASME Y 14-100M;

For complete identification , the organization identifier, as used for design activity idenification, should be linked to the model, part or bulk material identifier.

- Different sources of manufacture or supply for items cover by the same product identifier.

6. The product configuration information identifier. This identifier is used to uniquely identify various types of configuration information (e.g., drawing, specification, or document number).

7. The file identifier. This identifier is used to distinguish one computer file from another (e.g., file name).

.

5.2.3.1 Model Identifier

The model identifier should be used to separately identify a product ~~from other products~~ within a greater family of products and may be used to identify subtiered products which are determined to require specific configuration management (i.e., development, identification, and control) activities during the product life cycle~~. The model identifier designates a product above the item (e.g., unit, assembly, part) within the product structure, which is designated for configuration management. The model identifier should be a non-changing identifier throughout the product lifecycle independent of the application of the product. When a significant change is incorporated into the product to create a similar but unique product and the original product stillexists a new model identifier should be created. The model identifier should be used as the basis for the product level unique unit identifier change management and serialization.~~

~~**5.2.3.1.1 Model Name**~~

~~A consistent and representative naming convention should be applied to each model. The result of this naming convention is the model name. This model nameshould be applied consistently to each identifier and used to relate the model identifier to the associated information identifier (e.g., requirements information specification; and applicable design information drawing name), and the applicable product identifier.~~

5.2.3.2 Product Part/Item Identifier

Each product part/item in the product structure should be assigned a unique identifier. The product identifier should provide:

- A unique identification of that product part or item;
- Traceability to the applicable product definition information.

~~Unlike the model identifier, t~~The product part identifier should be changed if the functional and/or physical interchangeability between the old and new product configuration is affected~~, as soon as product re-identification criteria, delineated in the handbook, are affected by a design change. If the configuration of the product is changed, the product part identifier should be changed to identify the new configuration of the product.~~

5.2.3.3 Identification of Individual Units of a Product

PRINCIPLE 2-3B : Assign a unique unit identifier~~, like a serial number,~~ to individual units of a product when there is a need to distinguish one unit of the product from another.

The most widely accepted method of identifying an individual unit within a series of like units is by assigning a unit identifier to each unit along with its product identifier and enterprise identifier. ~~(~~This process of issuing unit identifiers is referred to as serialization.~~)~~ The combination of the product identifier and unit identifier is never duplicated within the enterprise that is covered by the enterprise identifier.

Each unit within a product should be~~-~~ assigned a unique unit identifier along with it's model/product identifier when :

- products with the model identifier can be provided with customer options,
- products have warranties,
- ~~□~~
- each unit must be subject to individual functional and performance testing or screening

~~Individual units of a product should be assigned a unit identifier along with its product identifier and design organization identifier.~~ A unit identifier should not be repeated unless it's serialization base (i.e., model or product definition information identifier) is changed.

~~For traceability, each unit within a product should be assigned a unique unit identifier when:~~

~~- Products within derived from the same product definition information or having the same model identifier can be provided with customer different options;~~
~~- Products having with warranties~~
~~- Each unit is subject to individual testing or screening with resulting data to be recorded or if failure reporting is required.:~~
~~- Different items when subject to being matched must be serialized.~~

PRINCIPLE 2-3C : When a product is modified, the product identifier is updated to reflect the new configuration. The unit identifier, and model identifier remain unaltered.

When products have been modified, they retain their original unit identifier (e.g., serial number) even though their product identifier (e.g., part number) is changed to reflect the new configuration. Retaining the unit identifier and model identifier enables traceability for each product and unit.

~~**5.2.3.3.1 Identification of Groups of Units (Lots)**~~

~~**PRINCIPLE 2-3D: A series of units (or a batch) of a product is assigned a unique group identifier when it is unnecessary or impracticable to identify individual units but nonetheless necessary to correlate the units (or the batch) to a process, date, event, or test.**~~

~~To provide traceability for products parts which are not individually identified, group identifiers should be used. Group identification is accomplished by designating all units of the group with a common number (e.g., all units of a product manufactured in a single production run). Group identifiers are not to be duplicated within an unchanged serialization base.~~

5.2.3.~~3.2~~4 Organization Identifier

As used in practice, the code denotes the organization responsible for the design and/or manufacture of a product. A product may be design~~a~~ted by one organizational entity and manufactured by a different organizational entity with a different organizational code.

5.2.3.~~4~~5: Identification of Bulk Material ~~(Lots or Batches)~~or Groups of Units

PRINCIPLE 2-3D: A series of units of a product is assigned a unique group identifier when it is unnecessary or impracticable to identify individual units but nonetheless necessary to correlate the units to a process, date, event, or test.

To provide traceability for bulk material, batch (or lot) identifiers should be used. Batch identification is accomplished by designating the entire quantity of the batch with a common number (e.g., one-time processed quantity of propellant). Batch identifiers are not to be duplicated within an unchanged product identifier.

To provide traceability for products or parts which are not individually identified, group identifiers should be used. Group identification is accomplished by designating all units of the group with a common number (e.g., all units of a product manufactured in a single production run).

5.2.4 Identifying and Maintaining Information ~~and Maintaining Relationships~~

Identifying information is critical ~~to maintain relationships and~~ to ensure integrity of the information as it is used, processed ~~-~~and distributed. ~~Good identifying practices include:~~

~~- unique identification of information representations (e.g.;files, drwawings, documents)~~

- ~~compliance with file and database data policies~~
- ~~retention of essential file and version relationships;~~
- ~~known data status;~~
- ~~controlled access .~~

PRINCIPLE 2-4A : Uniquely identify information so that it can be correctly associated with the applicable configuration of the product.

Information related to the product ~~-~~configuration (e.g., reports, specifications, data sets, correspondence) ~~are~~ is uniquely identified so that it can be ~~referred~~ referenced~~to~~ ~~precisely~~ and retrieved when necessary. ~~Configuration information cite, or are linked to the = identifier and revision with which they associate. Methods of identifying information can vary considerably; however, unique identification includes key data elements such as:~~

- ~~a unique identifier for the originator/design organization;~~
- ~~a unique identifier assigned by the originator/design organization (for example, a number, alphanumeric identifier, or title/subject);~~
- ~~a revision or version identifier (e.g. number, letter, release number or date).~~

5.2.4.1 Identifying and Managing Information Representations

PRINCIPLE 2-4B : Apply information identification rules to maintain representation and version relationships.

An effective system of managing information, document representations by key data elements should be employed to enable information to be accessed or retrieved in a controlled manner. Relationships within the information should be preserved to maintain integrity of information and enable retrieval by users.

Information can have several different, equally valid, representations, such as two different word-processing formats.

5.2.4.2 Maintenance of Information and Product Configuration Relationships

PRINCIPLE 2-4C: Maintain relationships between information, information requirements, and the related product configuration to ensure accurate information retrieval.

Information is uniquely identified to establish information identification and to enable traceability to specific product configurations. An effective system of managing the relationships of information items, information representations and key data elements must be employed if the correct data is to be accurately retrieved.

5.2.5 Configuration Baselines For Products

PRINCIPLE 2-5A : A configuration baseline identifies an agreed-to description of the attributes of a product at a point in time and provides a known configuration to which changes are addressed.

Configuration baselines provide a ~~the~~ basis for Configuration Management. Configuration baselines are used to define and describe the agreed to product attributes~~. They should~~ and be used to provide the ~~agreed to~~ basis for managing change, and may be used as the basis for estimating required costs/resources and prices. Configuration baselines may have a sequence and relationships to one another (hierarchies).

~~The CM process is applied to each baseline and to all the information included in it. CM planning identifies: **Move to Planning 5.1.X**~~

- ~~what baselines are to be established;~~

- ~~when and how baselines will be defined;~~
- ~~the process for ensuring document and file integrity;~~
- ~~the authority to approve baseline changes;~~
- ~~if and when the level of change authority will transfer~~
- ~~the process by which proposed changes to the baseline will be dispositioned~~

PRINCIPLE 2-5B: Before any product information is considered part of a configuration baseline, it should be complete, valid, and suitable for use.

A release process is employed to validate the product or information and file integrity before it is established as a configuration baseline. The release of each product's information reflects the review for accuracy and completeness. The release also reflects the approval signifying that the information is suitable for use and establishes a new configuration baseline. Establishment of a configuration baseline should include designation of the level of control to be applied to the configuration baseline.

PRINCIPLE 2-5C: The current configuration baseline is the previously approved baseline plus any ~~unincorporated~~ approved changes. Previous configuration baselines are retained ~~until they are no longer~~as long as they are needed.

Configuration baselines provide affected parties assurance of stability and consistency of product attributes. They also provide a common communication of product definition and permit the transfer of change approval authority over a product's life cycle.

Once configuration baselines are established, they should be managed and updated through a configuration change management process (see 5.3) and through continuing audit and verification (see 5.5).

5.2.6 Configuration Identification Recovery

PRINCIPLE 2-6: Maintaining configuration information is important because time consuming and expensive recovery may be necessary if configuration information of operational units of a product do not match the actual units, or if such information does not exist.

Specific manpower-intensive actions are sometimes necessary to recover the configuration identification, or establish a workable set of configuration information for a product, or to establish a workable set of configuration information for an existing product without adequate documentation.

5.2.7 Interface Control

PRINCIPLE 2- 7: Identify interfaces and establish mutually agreed-to control of common attributes for product boundaries which interface to a product.

Product attributes that are a part of a configuration baseline include defined interfaces with products that are developed, produced, and supplied. Interfaces are documented in a product's configuration information. To document and control the interface, a relationship must be established between the interfacing boundries.

If the relationship is a buyer-seller relationship, the interface definition is included as part of the purchase agreement**. MOVE TO ANNEX C**

If there is no direct relationship, an interface agreement is established delineating procedures for defining and maintaining the common interface between the ~~boundries~~boundaries. **MOVE TO ANNEX C**

5.3 Configuration Change Management

FUNCTION 3 :Control changes to a product using a systematic, measurable change process.

Configuration change management is a process for managing product configuration changes and variances. The purpose of the change management function include the following:

- enable change decisions to be based on knowledge of complete change impact;
- limit changes to those which are necessary, or offer significant benefit;
- facilitate evaluation of cost, savings, and trade-offs;
- ensure that customer interests are considered;
- provide orderly communication of change information;
- preserve configuration control at product interfaces;
- maintain and control a current configuration baseline;
- maintain consistency between product and documentation;
- document and limit variances;
- facilitate continued supportability of the product after change.

Regardless of the type of product or phase of its life cycle, a change to a product is accomplished using a systematic, measurable change process. Once the product requirements (and hence, the product) have been **approved** (and established as a baseline) by an authorized management activity, changes to the baselined requirements are effected only after the proposed changed has been approved using this change process. The process includes identifying the need for a change; documenting change impact; evaluating and coordinating the proposed change (including approval/disapproval); incorporating the approved change in the product and its related baseline configuration documents; and verifying consistency with the product documentation . In addition, the process also encompasses the identification, documentation, approval, and implementation of variances from baselined product requirements.

The generic change management process model shown in Figure 4, which is valid for either internal change management or management of changes to products under customer configuration control, consists of the following subordinate processes:

a. Change identification process: Within this process the requested change is conceptually visualized to determine one or more approaches to accomplish it. The change is described, preliminary assessments of the effect (of making, or not making) the change are made. A proposed point of incorporation (effectivity) is chosen. The change is classified to determine the required levels of processing and approval authority, including customer approval or concurrence, when required (see 5.3.1).

b. Evaluation and coordination process: Within this process the change is thoroughly considered, and this process is completed when a decision is made to implement a change(see 5.3.2).

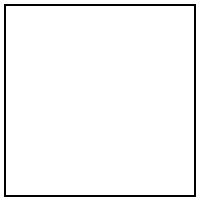


Figure 7 — Change Management Process Model

5.31 Change Documentation and Identification

PRINCIPLE 3-1A : Document and uniquely identify each change.

The objective of the change documentation is to: provide a description of the requested change and its impact for evaluation; determine the appropriate level of approval; choose the appropriate format (information content) for describing the change; and, provide a unique identifier for the change request.

In this standard, the originator of a change request is referred to as the "change requester." The change requester may be a member of the product development or production team, an operator or user of the product, the product test activity, or a customer in any other capacity. The activity or individual with technical responsibility for the product and the baselined configuration information is referred to as the "change sponsor."

Figure 8 illustrates the key elements of the change identification process and the questions that should be answered to prepare the change request for evaluation.

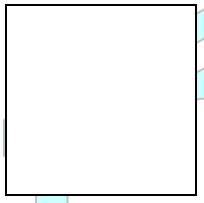


Figure 8 — Change Identification Process Model

5.3.1.1 Requesting Changes

PRINCIPLE 3-1B : Changes represent opportunities for improvement.

Changes are initiated for a variety of reasons, such as:

- — to provide new capabilities desired by a customer(s);
- — to make new product options available to customers
- — to enhance product support;
- — to insert new technology;
- — to effect product improvements;
- — to correct product defects or deficiencies;
- — to correct problems and prevent recurrence;
- — to eliminate safety hazard conditions;
- — to implement preplanned product improvement;
- — to reduce production costs and improve production efficiency;
- — to prevent schedule slippage.
- — Add 1 or 2 items relative to economics !!!
- —

Requests for change are prepared either by the change requester or by the change sponsor. The change sponsor makes preliminary judgments to identify the proper change authority and to determine the processing method and document format that are most appropriate. These judgments are affected by:

- — the need for the requested change;
- — the basic scope and description of the requested change;

— the definition of its impacts;
— the desired effectivity;
— its urgency and importance.

5.3.1.2 Classifying Changes

PRINCIPLE 3-1C: Classify requested changes to aid in determining the appropriate levels of review and approval.

One of the attributes of a change that determines the amount of information and the level of change decision is the classification of the change. Classification relates to the types of factors the change impacts. The classifications can be defined as follows, and they differentiate between changes with impacts to the functional and physical interchangeability and supportability of the product (termed "major" and changes that have no impact in those areas (termed "minor"). Both classifications discussed below include criteria that can be used to determine if the external customer (buyer) review, in addition to internal review, is required.

a. Major: A change classified as major is a change to the requirements of baseline configuration documentation (e.g., requirements, design release, or product configuration baselines) and has impact. A major change requires coordination and review by all affected functional groups, or product development teams, and approval by a designated approval authority, usually an individual who can authorize the resources needed for change implementation.

A major change typically requires external customer approval only if
— it impacts external customer (buyer) baseline requirements
— it impacts factors that affect external customer controlled activities.

b. Minor: A minor change corrects or modifies configuration documentation (released design information), and processes or parts, but does not impact any characteristics that would cause it to be classified as major. Minor changes do not impact customer requirements and typically require only internal approval at a level commensurate with their impact.

A minor change typically requires external customer involvement only if the following circumstances apply:
— the product configuration baseline has been established by the external customer
— the external customer is concerned with, or controls, the product's detail design in addition to its performance and interface attributes, and has imposed management procedures on the detailed design;
—). Other examples of effectivity expression are by model year, model designation, version number, and by product group identifying number (e.g., lot number, batch number). All of the methods of expression are intended to delineate, as clearly and precisely as practicable, which unit(s) of the product should be changed
— the contractual agreement stipulates that the external customer or his representative must review the change classification, or must approve minor changes. .

Table 4 — Classification of Engineering Changes

Characteristics of Engineering Change	Classification	
Factors	**Major**	**Minor**
a. Affects approved, baselined specification requirement[1] (e.g; product performance would be out of the specification limits).	●	
b. After product baseline, affects one or more of the following,: — products furnished by a customer; — safety; — compatibility with interfacing products, including such products as test equipment, support equipment and associated software; — delivered operation or servicing instructions;[2] — preset adjustments;[3] — interchangeability or substitutability of replaceable products, assemblies, or components; — change to a previously non-selected supplier, where supplier selection is specified; — user skills or physical attributes; — operator or maintenance training. (add form, fit and function)	●	
c.. Requires retrofit of delivered products (e.g., by product recall, modification kit installation, attrition, replacement during maintenance using modified spares).	●	
d. Affects cost/price to customer(s), including incentives and fees, guarantees, warranties, and contracted deliveries or milestones, and is an engineering change that does not impact factors a. through c.	●	
e. Affects configuration documentation (released design information) and product or processes, but does not affect factors in a. through d.		●

5.3.1.3 Documenting Change Requests

PRINCIPLE 3-1D : Clearly and completely document requests for change.

To adequately evaluate a change request, the request must be clearly documented. It is important to accurately and completely describe even minor changes so that an audit trail can be constructed in the event that there are unanticipated consequences or unexpected product failures. Establishing a configuration change process, which includes documentation of the impacts of each major or minor change, will help the program avoid significant expenditures in an effort to investigate and reconstruct a change after problems arise. In many cases, the cost of such investigation will more than offset the slightly higher cost of a comprehensive change documentation process .

Documentation of major changes includes the following information that is required to make an informed evaluation of the change and to clearly define the change:

— unique change identifier;
— originator organization and responsible individual;
— class of change;
— product(s), major components, interfacing products affected;
— contract and configuration baseline documents affected;
— scope and description of change
— effects on requirements;

— effects on specified operation; maintenance; servicing; operation and maintenance documents and training; spare and repair parts; support and test equipment; catalogs; marketing literature; etc.;
— reason and justification for the change; consequences of not doing the change;
— priority/urgency of the change;
— proposed change effectivity;
— requested approval date; and associated justification
— change implementation and delivery schedules;
— estimated cost increase or savings;
— alternatives.
— Product configuration information/product definition information

Minor changes are documented in the format used to release and communicate design changes. As a minimum, the following information is necessary:

— unique change identifier;
— originator organization and responsible individual;
— class of change;
— product, assemblies, and components affected;
— configuration documents affected;
— description of change;
— reason for the change;
— proposed change effectivity.

5.3.2 Change Evaluation and Impact Coordination

PRINCIPLE 3-2A : Consider the technical, support, schedule, and cost impacts of a requested change before making a judgment as to whether the change should be approved for implementation and incorporation in the product and its documentation.

The change evaluation and impact coordination process, modeled in Figure 9, encompasses the review of preliminary impact assessments, the determination of required change effectivity, the establishment of cost/price, and the disposition (approving, deferring for more research, or disapproving) of the change.

5.3.2.1 Change Impact Assessment

PRINCIPLE 3-2B : Determine potential effects of a change and coordinate impacts with the impacted areas of responsibility.

The impact assessment details what would be affected by the change and ensures that all potential effects are known. This information is essential to determine effectivity (see 5.3.2.2). The effectivity enables the impact to be quantified and the total implementation of the change to be priced and scheduled. The functional areas normally possess the specific detailed knowledge required for an accurate assessment. Change Boards are a means of achieving the final coordination necessary to evaluate a change and assess its impact. (See 5.3.2.4)

(*** the infigure reference to figures 5 & 7 are not correct !!!)

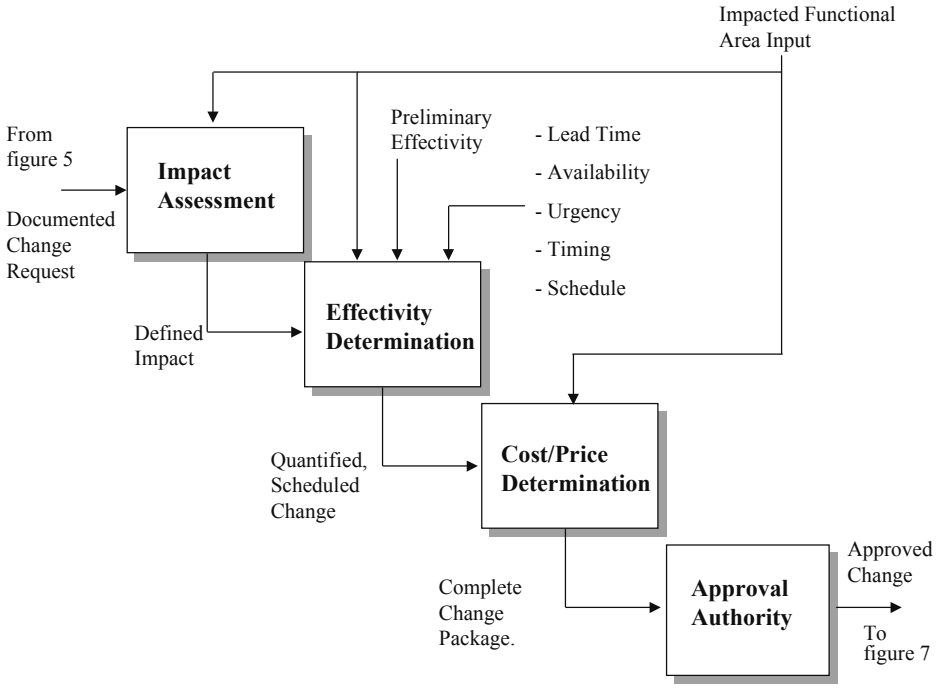


Figure 9 — Change Evaluation and Impact Coordination Process Model

5.3.2.2 Change Effectivity Determination

PRINCIPLE 3-2C : Determine the effectivity for each change. The change effectivity specifies which unit(s) of the product are to be changed and/or the point of production break-in and/or which products are included in retrofit/recall.

**** Revised principle 3-2C ******
The effectivity of the change must be determined so that the total impacts of the change can be quantified and the change can be priced and scheduled.

Effectivity is expressed in different ways depending on product type and quantity or rate of production. Several common means of expressing effectivity are by product unit identifying number (e.g., serial number) and by date code (e.g., date of manufacture). All of the methods of expression are intended to delineate, as clearly and precisely as practicable, which unit(s) of the product should be changed.

PRINCIPLE 3-2D : Ensure support and service areas can support the changed product before distribution.

effectivity determination typically requires the balancing of a number of other considerations, such as:

- urgency of the change (e.g., is safety involved);
- parts and materials on hand (e.g., can implementation be delayed until they are depleted, can they be modified, or do they need to be scrapped?);
- the need to support multiple configurations because all existing units of the product will not be updated, or will not be updated at the same time;

timing of the introduction of the changed product with respect to customer preferences and needs, competition, and marketing strategies.

5.3.2.3 Change Cost/Price Determination

PRINCIPLE 3-2E : Ensure the decision maker is aware of cost factors in making the decision.

Determining the total change costs, or savings, is usually one of the most critical factors that must be addressed in making a decision about a change. The decision should be based on cost/benefit analysis covering the remaining product life cycle. Cost estimating and pricing of a change cannot be effectively accomplished without the knowledge resulting from the impact assessment and effectivity determination. All cost factors considered, include whether the cost relates to the increased/decreased price for new parts, the scrapping of parts on hand, new tooling/software required for manufacturing the product, the recall and retrofit of already purchased units, and the increased/decreased effort and resources required to fulfill service contracts for customers

That knowledge facilitates not only determination of the immediate cost of making the change but also of the expected costs that will be incurred in the future because the change is made. The CM process ensures that the decision maker is aware of all cost factors in making the decision.

5.3.2.4 Change Approval Authority

PRINCIPLE 3-2F : Decisions for change approval/disposition are made by an appropriate authority who can commit resources to implement an approved change.

The approval authority for a change can be delegated depending upon the classification of the change. As the life cycle progresses, the change authority often transitions to individuals with greater management and fiscal responsibility because the effect of a change can be more widespread and, as a result, the cost impact of change decisions are normally greater. Each organization should establish its own change authority levels taking some or all of the following factors into consideration:

- the phase of the product life cycle;
- the extent of technical, support, schedule and cost impacts;
- the customer involvement and contractual requirements;
- the product attributes subject to formal control;
- the organizational structure and relationships within the enterprise;
- the various levels at which change authority is vested;
- the period of performance during which that level of control applies.

An individual author of a document (such as a drawing or a specification in working status) practices the simplest, most informal level of configuration control. The individual controls the document's content and may unilaterally change it. If generation of the complete document is a group effort, each author working on his assigned portion also has unilateral control, until such time as the individual portions are consolidated into a common draft. The initial consolidated draft then becomes the governing revision. Even though it may still be in working status, responsibility for its management passes to a lead individual. The individual contributors can no longer change their portion of the governing revision (current configuration) unilaterally without coordinating with the leader. When the draft revision of the document is finalized, it is released. The released document is provided to users outside the group to perform required work, the authoring group relinquishes its authority to unilaterally modify their product without determining the effect such a change might have on the other users of the document. The control of the released document rises to a level of management with the authority to approve such changes. If work in process, or even scheduled future work is impacted by the document change, this higher-level approval is required. The process for obtaining approval may be relatively informal, or more structured, depending on the organizational interfaces and customer impact.

The most complex multilevel configuration control is practiced on projects in which authority for making change decisions is structured around tiered Change Boards. The change approval authority spans many

contractor and customer organizations. Each organization has defined limited authority to disposition changes to the portion of the product (the configuration baseline documents) under its cognizance. Those changes affecting baseline documents that exceed the change approval authority of lower levels are elevated to the higher level that controls those baseline documents.

5.3.3 Change Implementation and Verification

PRINCIPLE 3-3A: Implement an approved change in accordance with documented direction approved by the appropriate level of authority.

A model for the change implementation and verification process is shown in Figure 7. Planning for and implementing a change can be very simple or can involve many complex and interrelated considerations. The basic planning for implementation of the change (impact coordination) is accomplished during the engineering change evaluation before the change is approved. Once the change is approved, detailed implementation planning, which expands, but remains consistent with, the pre-approval planning, is normally required.

Implementation of a change involves the release of new or revised configuration documentation, including requirements and design information. It may involve changes to operation and maintenance information, build and test information, and sales information. The new or revised information is identified and released (see 5.2).

The release process should correlate the document revisions with the related change or changes. The format used to reflect the changes to the document depends on the method of document creation and reproduction. For a word-processed document, one perfectly acceptable change record may constitue of a redlined/strike-through version of the affected portions of the document.

PRINCIPLE 3-3B: Verify implementation of a change to ensure consistency between the product, its documentation, and its support elements.

Implementation of the change in the first, or only, affected unit of the product should be verified to ensure consistency between the product, its documentation and its support elements. In accordance with the change implementation plan, this verification process may involve a detailed audit of the product against its documentation; a validation of operation, maintenance, installation, or modification instructions; or a simple inspection.

The choice depends upon the nature of the product and the complexity of the change. If the change is being introduced into a production line, and if all future units will have the change incorporated via the normal production process, then it is normally sufficient to ensure that the manufacturing instructions contain the change, that they are released for use, (such as with a work order), and that the first articles produced are inspected for compliance. However, when support elements are impacted by a change, or the change is being retrofitted over a period of time to a large number of units, complete implementation and verification of the change can be a lengthy, incremental process.

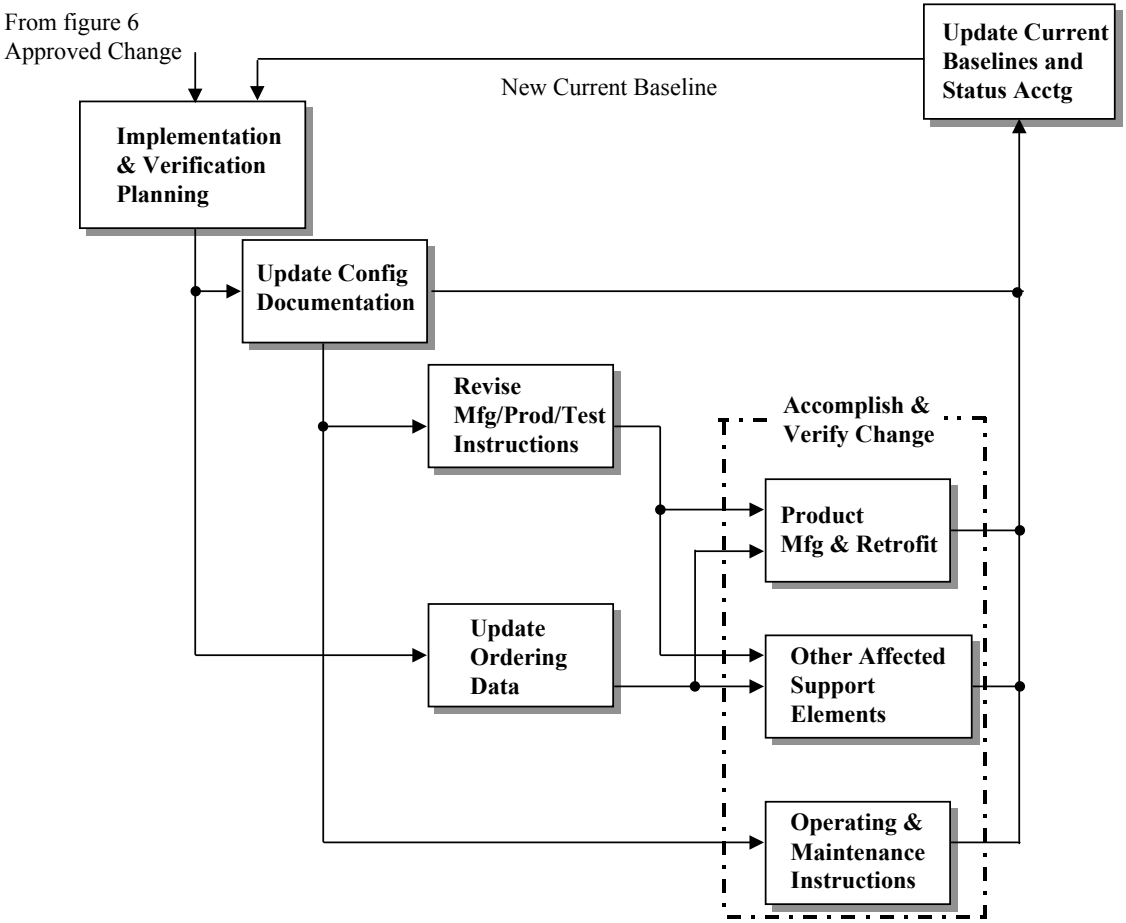


Figure 10 — Change Implementation and Verification Process Model

The implementation plan should define the extent to which the change to each unit, or support commodity, is to be verified and the records that are to be maintained (see 5.4). When the total quantity of materials, or parts, or kits, is ordered in incremental stages (e.g., per year, per month), it is also necessary to verify that the incremental ordering and supply operations are being completed.

5.3.4 Change Management Process applied to Variances

PRINCIPLE 3-4: Variances (temporary departure from specified requirements) are documented and authorized by the appropriate level of authority.

Products that incorporate a known departure from requirements, even if the requirements are internally specified, should not be delivered to a customer unless a variance has been documented and authorized. Unless unusual circumstances exist, a variance should not be processed if it would affect operation, support, or maintenance or if it would include the entire remaining number of deliverable units of the product. Rather, an engineering change should be proposed.

Requests for variances should always be documented, either by the variance (change) requester or by the variance (change) sponsor. Variances may be categorized, or classified, to facilitate the determination of the appropriate level of approval required for the variance and the action to be taken to prevent recurrence.

This ensures that the decision maker agrees with the delivery of units having the variance and provides an audit trail in case of problems in the future that might be related to the variance. Authorized variances do not constitute a change to the configuration documentation. If it is decided that a departure will be approved for, and incorporated in, all future units, an engineering change (rather than a variance) is processed. Similarly a variance should not be processed if it would aversely affect safety. or if it would

include the entire remaining number of deliverable units of the product. If it is decided that the departure from the requirements is necessary, an engineering change should be proposed.

Requests for variances should always be documented and should include the following information:

- unique identifier for the variance;
- originator organization and responsible individual;
  category of variance, if applicable;
  identifiers of the product(s) and components affected
- description of the variance including any impacts to performance, operation, maintenance, servicing, operation and maintenance training, spare and repair parts, support and test equipment, catalogs, and marketing literature;
- reason/justification for the variance;
- priority/urgency;
- proposed effectivity of the variance (limited quantity or time);
- corrective action to prevent recurrence and/or to eliminate the variance;
- consideration, if any, for accepting variant products;
- alternatives.

Variances may be categorized, or classified, to facilitate the determination of the appropriate level of approval required for the variance and the action to be taken to prevent a recurrence of the departure. , there is normally an investigation undertaken to determine the source of the departure and to determine what corrective action will be taken to prevent recurrence of the variance or to eliminate it completely as, for example, with an engineering change.

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5.4 Configuration Status Accounting

FUNCTION 4: TRACK product information to ensure that product configuration can be accurately determined throughout the product life cycle.

The purpose of configuration status accounting is to:

- enable retrieval of information concerning change decisions;
- support inquiries concerning design changes, investigations of design problems, warranties, and shelf and operating life calculations;
- provide access to complete configuration information See Table 5 in annex C.
- provide a source for configuration history and traceability of product configuration information.

CSA provides access to accurate, timely information about a product and its documentation throughout the product life cycle. CSA correlates, stores, maintains, and provides readily available views and information of **product configuration information**. CSA information may include data with any of the data status levels of pending, current and historical. Various kinds of information resulting from the CM process are part of CSA.

CSA satisfies both supplier and customer needs for access to information. CSA improves capabilities to identify, produce, inspect, deliver, operate, maintain, repair, and refurbish products.

5.4.1 CSA Information

PRINCIPLE 4-1A : Systematically record, safeguard, validate, and disseminate product information.

CSA information is a by-product of the CM process. The effectiveness of CSA is dependent on the quality of CM implementation. CSA must be supported by CM process to ensure the information is systematically recorded, safeguarded, validated, and disseminated.

PRINCIPLE 4-1B Methods, processes and procedures must be established to provide controlled access to CSA information.

Management of access privileges for authorized users is esssential for effective Data protectection. Access privileges vary according to the nature of the data and the needs of the user. Digital data media will be used for storage and retrieval.

PRINCIPLE 4-1C: Configuration information is captured as it evolves over the product life cycle

CSA requires that information be captured throughout the life cycle of the product. See table 5 in annex C.

5.4.2 CSA System

PRINCIPLE 4-2 : Data collection and information processing system requirements is determined based upon the need for configuration information.

CSA data is collected from dedicated data sources within engineering, project management, manufacturing, quality assurance, logistics support and customer or user organizations. The requirements for the depth of product configuration information determines the content of the data collection, storage, processing, and distribution.

5.5 Configuration Verification and Audit

FUNCTION 5 : The product configuration information is verified and audited to ensure that requirement attributes are met and accurately documented.

The purpose of the configuration verification and audit function is to:

-- verify the established product attributes in the **product definition information** and the configuration baseline have been achieved by the product,

-- ensure that the **product configuration information** is accurately documented, and continues to be achieved through out the lifecycle, including in the post-development life cycle phases; and

-- establish confidence that the CM process is performing as intended.

Configuration audits focus on the verification data to prove the product attributes have been met. product attributes –

Figure 11 depicts a simple flow diagram for configuration verification and audits. The dashed arrows indicate specific points where the configuration verification and audit function is relevant. These verifications and audits can be performed as one-time audits, incremental audits and CM process surveillance.

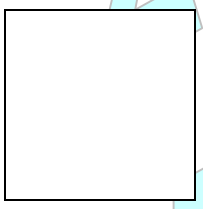

Figure 11 —Configuration Verification and Audit Assurances

5.5.1 Product Configuration Information Verification

PRINCIPLE 5-1 : Product attributes are verified by a systematic comparison with the associated results of product tests, analyses, inspections, demonstrations or simulation models.

The product attributes are verified to assure conformance with the configuration baseline information. Verification methods are carefully and purposefully planned in the most efficient manner to prove that all product attributes are addressed and met.

5.5.2 Configuration Management Process Surveillance

PRINCIPLE 5-2: Maintain surveillance over the configuration management process to ensure it is being followed and remainsin compliance with requirements.

The configuration management process is periodically reviewed to ensure performance and to enable continuous process improvement.

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6 Application Notes

NOTES

1 EIA 649 is a guidance document. It is not intended to be a compliance document in a contract for purchase and acquisition of a product. It may be used as a source for applicable information to prepare such items as a request for proposal or an evaluation or certification checklist. The application of appropriately selected principles and practices to a product, or on a project, will enable the user to plan and document an appropriate configuration management program for that product or project environment.

2 Configuration management practices should be applied selectively and to a degree commensurate with the product application environment. A configuration management practice should not be implemented solely because an evaluation standard, such as the ISO-9000/10000 series of Quality Programs, addresses the subject. In circumstances where given practices are not necessary, evidence of configuration management planning, and a rational basis for selection of appropriate CM practices, should be adequate to satisfy the evaluation criteria.

3 This standard should be used to plan, design, implement, and sustain CM systems that effectively serve the purposes of the enterprise. Because this standard contains the basic principles, it can be used to guide and evaluate the effectiveness of planned or practicing CM systems. Example uses are:

— an auditor writing evaluation criteria;
— an evaluator who is selecting a supplier
— an author drafting a CM plan.

Point to Annex C, Mention Handbook, EIA-836, EIA-859 (proposed)

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Annex A Configuration Management Principles (Informative)

Annex B Guidance for Application of this Configuration Management Standard (Informative)

1. **Purpose**

The purpose of this Annex is to provide guidance for the application of this CM standard to an enterprise. This Annex is intended to suggest a framework which will establish the basis for development, application or improvement of the implementation of a CM process.

2. **Background:**

This Annex provides a basis for determining the degree or level of requirement for CM. Implementation of CM processes based on this standard will be unique and their effectiveness will, to a great extent, be dependent upon how well the CM process is understood and followed by implementing organizations and people. Common understandings of things such as CM: Roles and Responsibilities, Authorities, Procedures, Tools, and methods which implement the five CM functions is essential.

3. **Considerations for Application:**

The steps that follow are intended to complement and be used in conjunction with Principles and practices which are included in Section 5.

. *Develop CM requirements*

Identify and assign responsibility for CM implementation to a person or organization. It is important that this person have corresponding implementing authority, possess or acquire CM expertise and that the assignment be communicated to affected organizations and people. Implementation of CM requires sound judgment to balance the risks associated with CM implementation.

Develop implementation requirements for each of the CM functions to assist in CM process evaluation. Maintaining traceability to the basis of each requirement will reduce errors of omission or duplication. These requirements may be the basis for internal, external, or contractual agreements.

Consider CM as an integrated process and include impacted organizations such as engineering, procurement, production, maintenance, operations, and information management throughout the entire implementation process.

Establish common CM terminology and definitions. Involvement by impacted people and organizations in terminology development will improve acceptance and significantly reduce miscommunication.

Plan CM Process Implementation

Establish CM roles and responsibilities for organizations and impacted people. CM roles and responsibilities are often assigned to people outside a CM organization.

Inventory and link assets (e.g. procedures, information systems, tools,) to the requirements. Perform evaluations to eliminate any gaps or duplications and determine resource needs through the use of techniques such as flow charting, comparison tables, or compliance matrixes.

Develop implementing methods and procedures, align existing assets and, if required, acquire resources to perform CM functions. Support organizational changes with free-flowing bi-directional communication, train personnel to perform assigned CM responsibilities.

Monitor and Maintain CM Requirements and Process

Development, evaluation and reporting performance metrics, results from surveillance audits, these can provide a basis to initiate process improvement, corrective actions which can lead to process maturity. Mitch to expand.

Annex C Informative Text for the CM Functions

Annex D Related Documents (Informative)

This industry standard relates to other existing documents as follows:

D.1 Relation to Other Industry Standards

EIA 649 is compatible with EIA 632, "Processes for Engineering a System" and IEEE[1] /EIA 12207.0, 12207.1 & 12207.2, "Industry Implementation of International Standard ISO/IEC 12207: 1995 (ISO/IEC 12207) Standard for information Technology - Software Life Cycle Processes - Life Cycle Data."

EIA 836 (2549???) Use language that was provided by Al Lager in the initial 5.6 revision.

EIA 859 (DM Std???) To be obtained from Cindy Hauer at January Quarterly

The following ASME[2] standards that relate to engineering drawing practices are of primary importance since engineering drawings and associated lists are an essential element in defining product configuration (design information):

- ASME Y14.24, "Engineering Drawing Types"
- ASME Y14.34M, "Associated Lists"
- ASME Y14.35M, "Revisions to Engineering drawings."
- ASME Y14.100M, "Engineering Drawing Practices."

D.2 Relation to ISO 9000 and 10000 Series Quality Program Standards

The (ISO) 9000 Series Standards and their ASQ[3] equivalents are used to audit and evaluate a contractor's quality program. Within these standards there are broadly stated requirements that are met if the contractor has an adequate configuration management program implemented using the principles in EIA 649. Of particular importance are the following clauses within each of the ISO and ASQ documents:

- Design Control
- Document and Data Control
- Product Identification and Traceability
- Control of Nonconforming Product.

A similar relationship exists with ISO 10007 "Quality management – Guidelines for configuration management." ISO 10007 provides broad general guidelines that can easily be mapped to the principles and best practices in EIA 649.

D.3 Relation to ISO, ANSI and IEEE Software Standards

The following are useful references for configuration management practices unique to software, the requirements of which are compatible with the principles and practices in EIA 649:

- ANSI/IEEE Standard 610.12-1990, "Standard Glossary of Software Engineering Terminology"
- IEEE Standard 828-1990, "Software Configuration Management Plans"
- ANSI/IEEE Standard 830-1994, "Software Requirements Specification, Guide to"
- ANSI/IEEE Standard 1042-1987, "Guide to Software Configuration Management."

[1] Institute of Electrical and Electronics Engineers
[2] American Society of Mechanical Engineers
[3] American Society of Quality Control

In addition, ISO 9000-3, “Quality Program Standard for Software Development," bears the same relationship to EIA 649 as do the other quality program standards.

The Software Engineering Institute’s Software Development Capability Maturity Model (SEI/CMM) delineated in SEI-93-TR-024, provides a best-practice view of software development. In this view, CM is a defined process integrated as an essential element in the software engineering process. The CMM articulates the need for inter-organizational relationships but it does not prescribe any specific organization or methodology. The CMM and EIA 649 are fully compatible and complementary,

D.4 Relation to US Military Standards and Handbooks on Configuration Management

Military Handbook 61 (MIL-HDBK-61A(SE)), provides guidance to military acquisition program and CM managers in relating Industry EIA 649 to their programs in the environment of the standard DoD CM AIS, and the practices associated with performance-based acquisition.

Another useful reference is MIL-HDBK-505, “Definition of Item Levels, Item Exchangeability, Models, and Related Terms,” which defines the standard terminology used in naming equipment used by the military.

An Acknowledgement of Participants responsible for the development/revision of the ANSI/EIA 649 Standard follows.

Annex E Acknowledgment of Participants in EIA Standard 649

EIA/IS-649 Core Working Group	EIA 649 Core Working Group	EIA 649 Rev. A Working Group
Alan Lager - MLR Associates	**Alan Lager** - MLR Associates	
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Leon Waldron - Boeing	**Lee Foley** - Honeywell	
Fred Bahrs - CMstat Corporation	**Joseph Mystkowski**, Northrop Grumman	
Nan Barnes - Litton Data Systems	**James Leonard** - Lockheed Martin	
Lee Foley - Honeywell	**Bill Bichel** - McDonnell Douglas	
Bill Dean - US Air Force Institute of Technology	**Bill Dean** - US Air Force Institute of Technology	
Bob Beermann - US Army (ARDEC)	**Adrienne Scott** - TRW	
Chris Denham – EIA	**James Martin**, Raytheon Systems	
	Chris Denham - EIA	

Many others, too numerous to list, provided invaluable guidance, critique, and feedback during EIA Quarterly meetings and on Panels at the annual EIA Engineering and Management Workshops from 1994 - 2001. In addition, the core groups would like to acknowledge those who took the time to provide verbal, written and e-mail comments, observations, and words of encouragement.

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